Water Quality and Other Expected Benefits

Groundwater Quality Improvement

This Project will increase stormwater capture and groundwater recharge to the East Raymond Basin. The groundwater recharge occurs by percolation of that captured stormwater through the pervious soils underlying the spreading grounds. This process effectively filters the stormwater resulting in high quality water added to the groundwater basin. This recharge of percolated stormwater is considered higher quality than the existing water in the East Raymond Basin. It is noted that the water purveyors from the East Raymond Basin have experienced water quality concerns in some wells. The new stormwater recharge effectively dilutes the lower quality existing water in the basin. A copy of the draft Raymond Basin Groundwater Recharge Technical Analysis Stormwater Capture Program January 26, 2011 report prepared for the Raymond Basin Management Board by Geoscience Support Services, Inc. is attached as Appendix 9-A. The report discusses Geoscience's groundwater model and looks at changes in contaminant levels (TDS, Nitrate and Perchlorate concentrations) predicted based on increased recharge to the Basin by increased stormwater capture. Preliminary results of the model demonstrate that increased stormwater capture has beneficial improvements to the overall water quality of the Basin.

Enhanced Ecosystem Habitat

The Bay-Delta ecosystem is sensitive to water levels and pumping activities associated with water exports for the State Water Project and Central Valley Project. As the Project reduces demand for Metropolitan Water District of Southern California (MWD) water supplies, it indirectly decreases demand for Bay-Delta exports, assuming all demands on other water users is unchanged. Reduced water exports from the Bay-Delta may increase habitat quality and associated services provided by the ecosystem, such as recreational opportunities. Prior studies have monetized these services as well as willingness-to-pay for general improvements in habitat (non-use values). Data limitation and Project budget constraints prevent monetization of these benefits.

Table 9.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Groundwater Quality Improvements	Qualitative	Local / Regional
Enhanced Ecosystem Habitat	Qualitative	Statewide

Distribution of Project Benefits and Identification of Beneficiaries

The Project water quality improvements will benefit local residents that rely on local groundwater supplies from the East Raymond Basin as a drinking water source.

On a statewide level, reduced water exports from the Bay-Delta would help mitigate declining ecosystem conditions there.

Table 9.2: Project Beneficiaries Summary

Local	Regional	Statewide
Local Residents	Greater Los Angeles Region	Bay-Delta

Project Benefits Timeline Description

The Project benefits will be received beginning in 2014.

Uncertainty of Benefits

There is some uncertainty associated with quantifying the water quality benefits and other expected benefits since they cannot be monetized.

Table 9.3: Omissions, Biases, and Uncertainties and their Effect on the Project

Benefit or cost category	Likely impact on net benefits*	Comment
Improved Basin water quality	+	Not monetized
Enhanced Bay-Delta Ecosystem Habitat	+	Not monetized

* Direction and magnitude of effects on net benefits

+	Likely to increase net benefits relative to quantified estimates
++	Likely to increase net benefits significantly
-	Likely to decrease net benefits
--	Likely to decrease net benefits significantly
+/-	Uncertain

The "Without Project" Baseline

If the Project is not implemented, local surface water that would be captured for groundwater percolation will not be available to improve the overall water quality of the East Raymond Basin. The reduction in available local water supply may result in negative impacts to the Bay-Delta ecosystem associated with the purchase of imported water.

Potential Adverse Effects from the Project

Any potential adverse effects from Project implementation will be mitigated.

Project Benefit Costs Comparison

The total present value of the Project costs and monetized and qualitative benefits are provided in Table 9.4.

Table 9.4: Benefit-Cost Analysis Overview

	Present Value (In 2009 Dollars)
Costs – Total Capital and O&M	$33,350,000
Monetizable Benefits	
Water Supply Benefits (Avoided water supply purchases – 518AFY)	$4,883,554
Water Supply Benefits (Avoided Project cost)	$18,284,858
Flood Damage Reduction	$117,992,441
Total Benefits	**$141,160,852**
Qualitative Benefits	**Qualitative Indicator****
Water Supply Benefits (Improved supply reliability)	+
Reduced Impacts to other infrastructure	+
Reduced Impacts to Quality of Life and Commerce	+
Water Supply Benefits (Enhanced Bay-Delta Ecosystem habitat)	+/-

** Magnitude of effect on net benefits
+/- (negligible or unknown)
+ (moderate)
++ (significant)

Methods used to Estimate With- and Without-Project conditions

Water Quality and other expected benefits were not monetized for this Project.

APPENDIX 9-A

Raymond Basin Groundwater Recharge Technical Analysis – Stormwater Capture Program

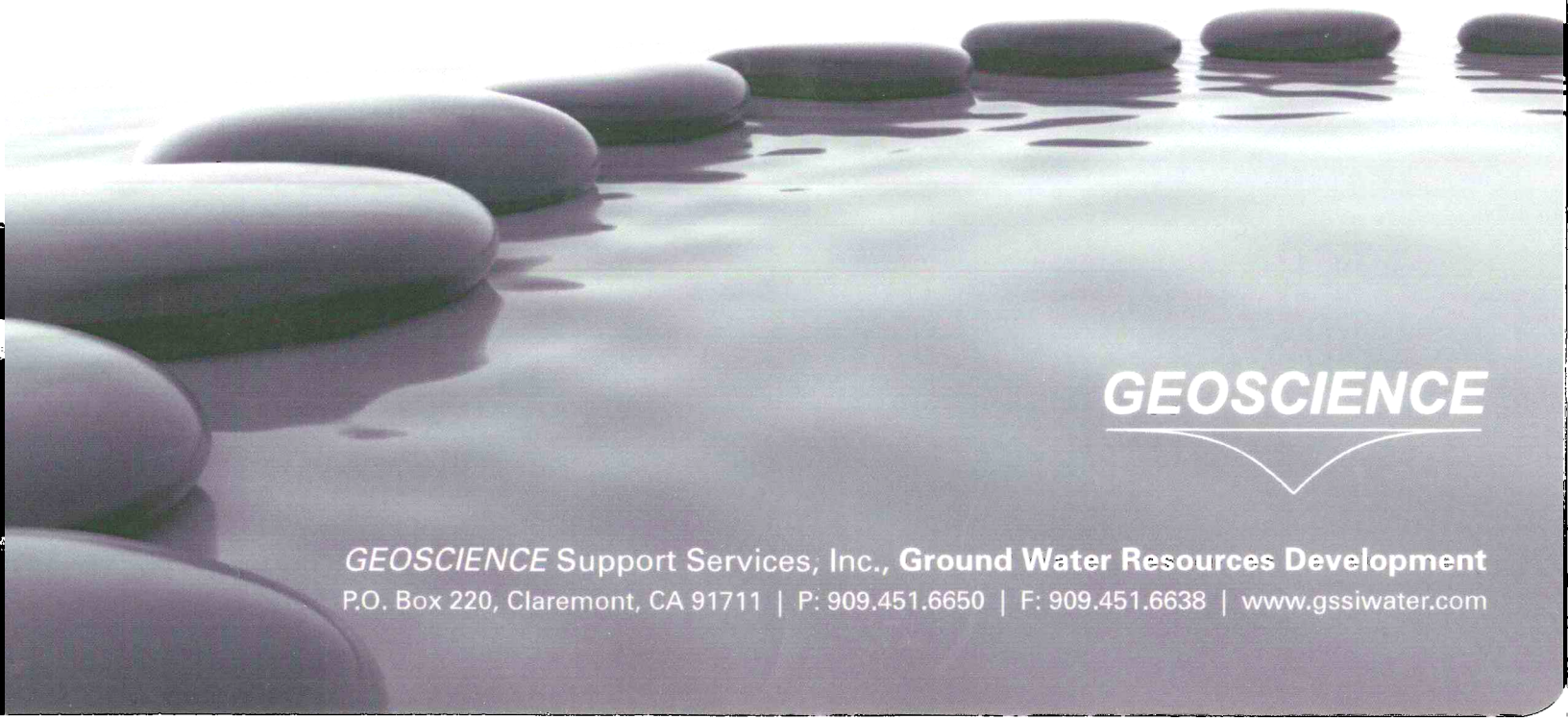
Raymond Basin Groundwater Recharge Technical Analysis – Stormwater Capture Program

DRAFT

PREPARED FOR:

Raymond Basin Management Board

January 26, 2011



GEOSCIENCE

GEOSCIENCE Support Services, Inc., **Ground Water Resources Development**
P.O. Box 220, Claremont, CA 91711 | P: 909.451.6650 | F: 909.451.6638 | www.gssiwater.com

RAYMOND BASIN GROUNDWATER RECHARGE TECHNICAL ANALYSIS
STORMWATER CAPTURE PROGRAM

CONTENTS

FIGURES

FIGURES (Continued)

FIGURES (Continued)

FIGURES (Continued)

FIGURES (Continued)

FIGURES (Continued)

FIGURES (Continued)

FIGURES (Continued)

FIGURES (Continued)

APPENDIX

Ltr.	Description
A	Selected Hydrographs for Transient Model Calibration (January 1981 through April 2010)

RAYMOND BASIN GROUNDWATER RECHARGE TECHNICAL ANALYSIS STORMWATER CAPTURE PROGRAM

1.0 EXECUTIVE SUMMARY

The purpose of this report is to present the results for a technical analysis of the Raymond Basin Groundwater Recharge Project (Stormwater Capture Program). The purpose of the Stormwater Capture Program is to increase local water supplies and independence from imported water (e.g., State Water Project and Colorado River Water) by using existing debris basins to capture and recharge surface runoff This project is one of eight individual projects developed by the Foothill Water Coalition (FWC) and the U.S Army Corps of Engineers for the Foothill Communities Water Supply Reliability Study (FCWSRS) The FWC is a local group of water agencies, which includes the Raymond Basin Management Board (RBMB), which is focused on securing the water resources by addressing issues related to population growth, drought and groundwater contamination within the foothill areas of Southern California.

In order to evaluate the groundwater level and water quality impacts from the proposed Stormwater Capture Program, the existing RBMB groundwater flow model was updated and refined. A summary of the tools and methodology used to update the existing RBMB model and to develop a groundwater solute transport model is included in this report. This report also summarizes the results of basin water level and water quality conditions for 2010 (Baseline), simulated stormwater capture at specific debris basins (Project 1), simulated surface water recharge at Eaton Wash spreading grounds (Project 2), an evaluation for improved surface water recharge at selected spreading grounds (Project 3), and simulated conditions under Project 2 and Project 3 (Project 4).

The scope of work performed during this analysis included the following:

- Evaluating and collecting geohydrologic and groundwater quality data from the RBMB and other water purveyors and agencies within the Raymond Basin,
- Updating and refining the existing RBMB model The update included refining the model cell size, boundary conditions, location of horizontal-flow barriers, location of pumping / injection wells, and converting model aquifer parameters;
- Extending the flow model calibration period from January 1981 through December 2008 to January 1981 through April 2010;
- Providing characterization of water quality conditions within the Raymond Basin for total dissolved solids (TDS), nitrate (as NO_3), and perchlorate for purposes of developing initial conditions, and for the selection of transport model calibration targets,
- Developing and calibrating a MT3DMS solute transport model for known water TDS and nitrate conditions within the Raymond Basin,
- Simulating various predictive model runs for the Baseline Run and Project Scenarios 1 through 4 using the refined RBMB model and solute transport model,
- Summarizing water budgets for subareas within the Raymond Basin for the Baseline Run and Project Scenarios 1 through 4,
- Providing predictive changes in groundwater levels between 2010 and 2032 for the Baseline Run and Project Scenarios 1 through 4,
- Evaluating movement of perchlorate from wells with elevated concentrations for the Baseline Run and Project Scenarios 1 through 4,
- Attending project progress meetings to discuss the flow model refinement, solute transport model development, calibration processes and results for both models, assumptions for model predictive runs, and results of the Baseline Run and Project

Scenarios 1 through 4, and

- Preparing draft and final technical reports.

A total of five predictive model runs were made using the refined RBMB model and solute transport model to assess the potential impacts of the Project scenarios on groundwater levels and water quality These model runs include:

- Baseline Run (No Project)
- Project Scenario 1
- Project Scenario 2
- Project Scenario 3
- Project Scenario 4

The following table summarizes the major components of the predictive model runs.

Scenario	Stormwater Capture at Rubio Canyon, Bailey, Sierra Madre Villa and Santa Anita Dam Debris Basins	Recharge at Eaton Wash Spreading Grounds from Diversions through Devils Gate / Eaton Canyon Pipeline	Improved Surface Water Recharge at Sierra Madre, Eaton Wash, Arroyo Seco and Santa Anita Spreading Grounds
Baseline (No Project)			
Project Scenario 1	X		
Project Scenario 2		X	
Project Scenario 3			X
Project Scenario 4		X	X

Based on the results for the Baseline Run and Project Scenarios 1 through 4, the following conclusions are made:

- Based on a water balance model developed for Project Scenario 1, the potential stormwater capture for the Bailey, Rubio Canyon, Sierra Madre Villa, and Santa Anita debris basins is estimated to be 104, 197, 363, and 1,243 acre-ft/yr, respectively, for a total of 1,907 acre-ft/yr.

- Results for Project Scenario 2 indicate that the additional artificial recharge at the Eaton Wash spreading grounds by diversions through the Devils Gate / Eaton Canyon Pipeline is approximately 3,054 acre-ft/yr

- For Project Scenario 3, the additional artificial recharge by improving surface water recharge in the Arroyo Seco, Sierra Madre, Santa Anita, and Eaton Wash spreading grounds is approximately 427, 887, 419, and 310 acre-ft/yr, respectively, for a total of 2,043 acre-ft/yr

- Project Scenario 4 assumes both Project 2 and 3 to occur simultaneously during the predictive period (2010-2032). Model results indicate that the additional artificial recharge to be 427, 887, 419, and 3,091 acre-ft/yr for the Arroyo Seco, Sierra Madre, Santa Anita, and Eaton Wash spreading grounds, respectively, for a total of 4,824 acre-ft/yr

- Under the Baseline Run (i.e., No Project) conditions, water level changes in the Monk Hill Subarea would range from a decline of 10 ft in the central and southeastern areas to an increase of 30 ft in the northeastern area. Change in groundwater levels within the Pasadena Subarea varies from a decline of 40 ft in the southeastern area to an increase of approximately 30 ft in the southwestern area. For the Santa Anita Subarea, water levels would decline by 30 ft to 50 ft.

- The change in groundwater levels by 2032 is predicted to improve (i.e., either increase more or decrease less) under all four Project scenarios within the Monk Hill, Pasadena, and Santa Anita Subareas as compared to the Baseline Run.

- The average annual groundwater storage would decrease 50 acre-ft/yr, increase 150 acre-ft/yr, and decrease 580 acre-ft/yr during the period 2010 through 2032 under Baseline conditions in the Monk Hill, Pasadena, and Santa Anita Subareas, respectively

- The change in groundwater storage during the period 2010 to 2032 is predicted to improve (i.e., either increase more or decrease less) under all four Project scenarios within the Monk Hill, Pasadena, and Santa Anita Subareas as compared to the Baseline Run.

- Results for model-predicted TDS concentrations in Year 2032 indicates that TDS concentrations in both model layers undergo very little change under Project Scenarios 1 through 4 conditions as compared to the Baseline conditions. Under Project Scenario 1, there are slight improvements in water quality (i.e., decrease in TDS concentration) in the vicinity of the Sierra Madre Villa and Bailey debris basins due to the lower TDS concentrations of stormwater captured under Project conditions. Slight improvements in water quality are also noticeable in the areas of the Eaton Wash, Arroyo Seco, and Sierra Madre spreading grounds under Project Scenarios 2, 3, and 4

- Results for model-predicted nitrate (as NO_3) concentrations in Year 2032 indicates that nitrate (as NO_3) concentrations in both model layers undergo very little change under Project Scenarios 1 through 4 conditions as compared to the Baseline conditions. Under Project Scenario 1, there are slight improvements in water quality (i.e., decrease in nitrate (as NO_3) concentration) in the vicinity of the Sierra Madre Villa and Bailey debris basins due to the lower nitrate (as NO_3) concentrations of stormwater captured under Project conditions. Slight improvements in water quality are also noticeable in the areas of the Eaton Wash, Arroyo Seco, and Sierra Madre spreading grounds under Project Scenarios 2, 3, and 4.

- Results for model-predicted perchlorate concentrations in Year 2032 indicate that the perchlorate concentrations in both model layers would not change under Project

Scenarios 1 through 4 conditions as compared to the Baseline conditions.

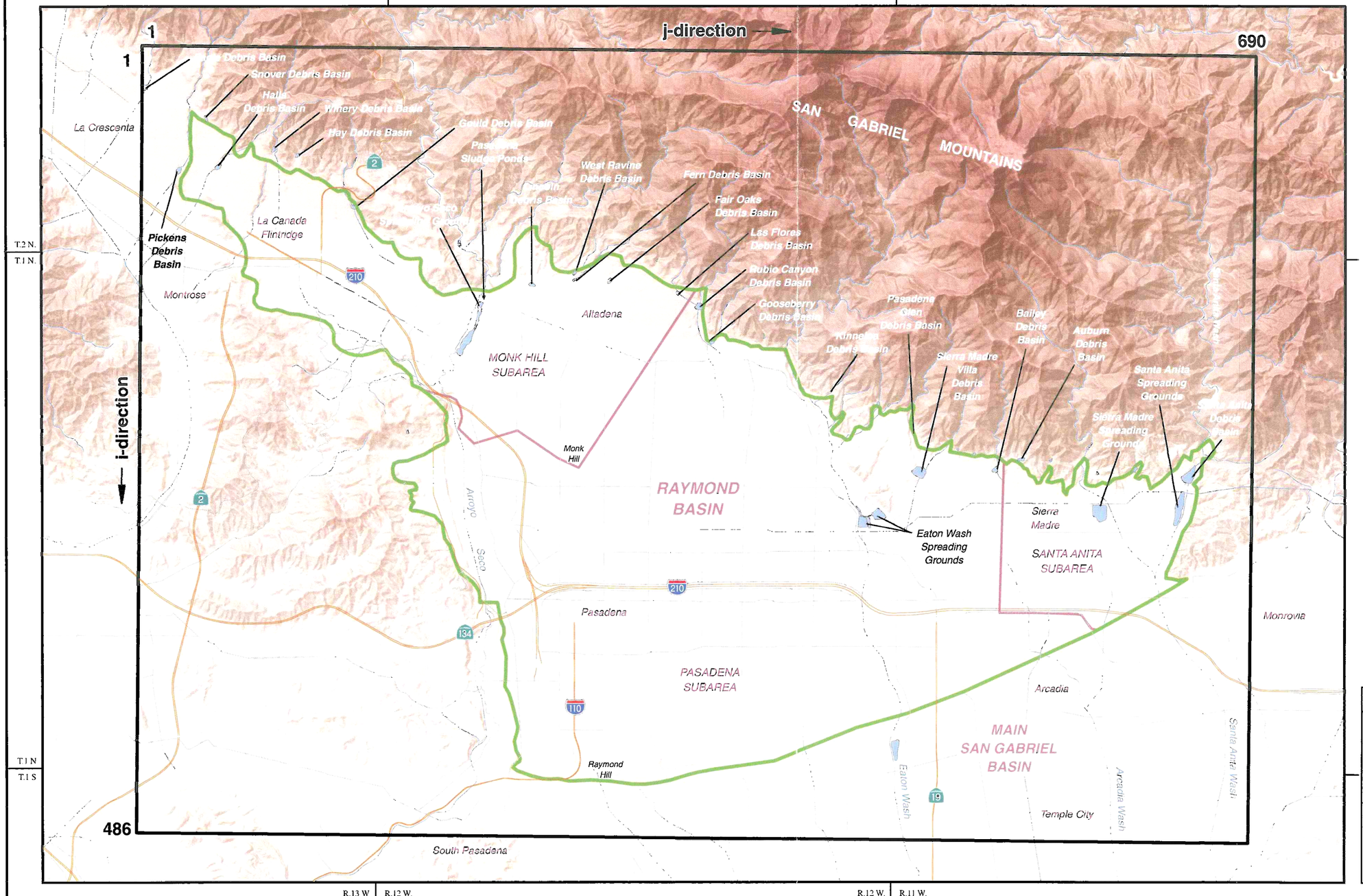
- Forward tracking was simulated using particles released from wells with elevated levels of perchlorate, tetrachloroethylene (PCE), and trichloroethene (TCE) Results of the particle tracking indicate that the groundwater flow paths under Project Scenarios 1 through 4 are the same as conditions under No Project (i.e., Baseline Run).

The refined RBMB groundwater flow and solute transport models are useful tools for evaluating water levels and water quality of the aquifer systems. However, it is a simplified approximation of a complex geohydrologic system. The accuracy of a model prediction is dependent upon the assumptions used. For example, the model assumes that no additional perchlorate would be added to the groundwater systems from the unsaturated zones. For urban areas, the TDS concentration was assumed to be 25 mg/L (precipitation's concentration) plus an urban increment of 250 mg/L and then adjusted by a factor of four for concentrating effects. These mass-loading assumptions may not represent actual conditions due to the lack of field data. The model simulations were not expected to predict the future TDS, nitrate (as NO_3), and perchlorate concentrations with a high degree of accuracy Rather, they were intended to allow relative comparisons between the Baseline Run (No Project) and Project Scenarios 1 through 4

RAYMOND BASIN MANAGEMENT BOARD,
US ARMY CORPS OF ENGINEERS & TETRA TECH, INC.

RAYMOND BASIN GROUNDWATER RECHARGE TECHNICAL ANALYSIS
STORMWATER CAPTURE PROGRAM

LOCATION AND GRID FOR THE REFINED RAYMOND BASIN GROUNDWATER MODEL

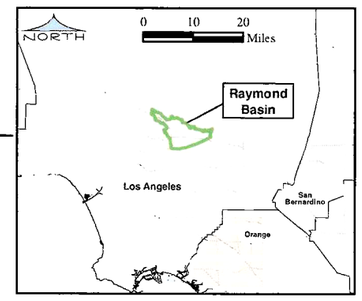


EXPLANATION

100 ft × 100 ft — Model Cell Size
486 x 690 cells x 2 Layers
= 670,680 Cells

Note: Model Grid Not Shown Due to Density of Model Cells

- Raymond Basin Boundary
- Raymond Basin Subareas
- Spreading Grounds or Debris Basins
- Refined RBMB Groundwater Model Boundary



26-Jan-11

Prepared by: DWB

Map Projection: UTM NAD 1927 Zone 11

NORTH
0 1 2
Miles

DRAFT

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Figure 1

GIS_proj/rbmb_ACE_model_1-11/0_Fig_01_proj_loc_model_grid_1-11.mxd